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STERIC IMAGING DEVICE
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Patent Claims

Claim 1

An imaging device characterized by the fact that it is constituted by a distance acquisition mechanism designed to acquire distance information on distances to the respective blocks of a photographic subject, an image acquisition mechanism designed to acquire, via a monocular optical system, image information on the aforementioned photographic subject, a steric image generation mechanism designed to generate a steric image based on the image information acquired by the aforementioned image acquisition mechanism and the distance information acquired by the aforementioned distance acquisition mechanism by assigning mutually different parallaxes to the respective blocks of the aforementioned photographic subject, and a steric image display mechanism designed to display the aforementioned steric image generated by the aforementioned steric image display mechanism.

Claim 2

An imaging device mentioned in Claim 1 characterized by the fact that the aforementioned distance acquisition mechanism is constituted by an irradiation mechanism capable of irradiating, onto the aforementioned photographic subject, beams almost simultaneously from multiple light emission positions bearing mutually different divergent irradiation distances to the aforementioned photographic subject, an imaging mechanism capable of independently picking up beam images arising as a result of the reflection, by the aforementioned photographic subject, of beams emitted from the respective light emission positions of said irradiation mechanism, and a computation mechanism designed to calculate distances from the light emission positions of the respective independently picked up blocks corresponding to the aforementioned respective reflection beams by means of computation based on the reflection intensity ratios of the aforementioned respective blocks.

Claim 3

An imaging device mentioned in Claim 2 characterized by the fact that the respective imaging mechanisms used by the aforementioned image acquisition mechanism and the aforementioned distance acquisition mechanism are mutually identical.

Claim 4

An imaging device mentioned in Claim 1 characterized by the fact that the aforementioned steric image generation mechanism is capable of varying the magnitudes of the aforementioned parallaxes.

Claim 5

An imaging device mentioned in Claim 2 characterized by the fact that the aforementioned steric image generation mechanism is designed to determine the magnitudes of the aforementioned parallaxes depending on the magnifying ratio of the image displayed on the aforementioned display mechanism.

Claim 6

An imaging device mentioned in Claim 1 characterized by the fact that the aforementioned steric image generation mechanism is designed to generate a binocular view image.

Claim 7

An imaging device mentioned in Claim 1 characterized by the fact that the aforementioned steric image generation mechanism is designed to generate a polyocular view image.

Claim 8

An imaging device mentioned in any of Claims 1 through 7 characterized by the fact that the aforementioned image acquisition mechanism is an endoscope.

Detailed explanation of the invention

[0001]

(Technical fields to which the invention belongs)

The present invention concerns an imaging device, and in particular, it concerns an imaging device designed to generate a sterically viewable image.

[0002]

(Prior art)

It is extremely effective, in the context of observing an image, to three-dimensionally observe a photographic subject from the standpoint of grasping the shape & size of the photographic subject. For this reason, various methods have been proposed with regard to imaging devices for displaying steric shapes such as mechanisms for displaying binocular view images (e.g., head mount displays, etc.) and, as Japanese Patent Application Publication Kokai No. Hei 11[1999]-308642 indicates, a mechanism for displaying a polyocular view image by using a lenticular lens. Likewise, various methods have been proposed with regard to imaging devices for imaging steric shapes of photographic subjects such as a mechanism for imaging a photographic subject as a binocular view image, a mechanism for imaging the same as a polyocular view image, etc.

[0003]

A stereo camera may be cited as the simplest constitution for displaying a steric image. According to this mechanism, photographs picked up by a pair of cameras positioned between left & right via an interval equivalent a human binocular parallax are induced to appear as a binocular sterically viewable image in a case where the photograph picked up by the camera on the right side of a photographic subject is viewed by the right eye and where the photograph picked up by the camera on the left side of a photographic

subject is viewed by the left eye. A camera capable of casually picking up binocular sterically viewable images by internalizing, within a singular housing, a pair of image pickup systems corresponding to both eyes, etc. have been devised based on the application of the aforementioned principle.

[0004]

Moreover, a polyocular view image can be obtained by photographing a singular photographic subject from multiple perspectives and by simultaneously displaying such images by using a steric image display device designed to use lenticular lenses.

[0005]

(Problems to be solved by the invention)

In a case where an attempt is made to obtain a binocular sterically viewable image based on the stereo camera format, however, a pair of image pickup systems are required, which is problematic in that the device size becomes enlarged. A technique wherein a steric image is picked up by attaching an attachment to the distal end of an ordinary camera lens, etc. have been known for solving this problem, but in any event, the device size becomes enlarged in comparison with ordinary cameras.

[0006]

Multiple image pickup systems, furthermore, are required for obtaining a polyocular view image, due to which the device size becomes further enlarged.

[0007]

A method wherein a singular camera is mobilized among multiple positions bearing mutually different perspectives has, furthermore, been proposed for obtaining binocular view images or polyocular view images, although since this method requires a substantial space for imaging operations, it is difficult to operate in a case where image pickup positions are limited.

[0008]

As has been mentioned earlier, furthermore, methods accompanied by device size enlargements and methods requiring image pickup operations from multiple pickup positions cannot meet practical needs, especially in the case of an imaging device used for a pickup within a narrow space (e.g., endoscope, etc.), for a compact device size is preferred.

[0009]

The objective of the present invention, which has been conceived in acknowledgment of the aforementioned problems of the prior art, is to provide a relatively compact steric imaging device capable of generating a sterically viewable image from ordinary images picked up by a monocular optical system.

[0010]

(Mechanism for solving the problems)

The imaging device of the present invention is characterized by the fact that it is constituted by a distance acquisition mechanism designed to acquire distance information on distances to the respective blocks of a photographic subject, an image acquisition mechanism designed to acquire, via a monocular optical system, image information on the aforementioned photographic subject, a steric image generation mechanism designed to generate a steric image based on the image information acquired by the aforementioned image acquisition mechanism and the distance information acquired by the aforementioned distance acquisition mechanism by assigning mutually different parallaxes to the respective blocks of the aforementioned photographic subject, and a steric image display mechanism 3 designed to display the aforementioned steric image generated by the aforementioned steric image display mechanism.

[0011]

At this juncture, a method wherein a steric image generation mechanism generates, as a binocular view image or polyocular view image, a steric image by conferring parallaxes

onto image information will be explained with reference to the principle diagram shown in Figure 2.

[0012]

First, a method for generating an image viewed from a position the perspective of which differs from that of a photographing position will be explained. It can, by hereby assuming a case where the perspective has shifted toward the right, be gleaned from an image (21b) viewed from a camera (20b) orchestrated at a hypothetical position shifted toward the right that a round object (1a), which is closer than a rectangular object (1b) to the photographing position, appears to be shifted more toward the left in comparison with said farther object. The shift magnitude, furthermore, proliferates in proportion to the perspectiveal deviation magnitude.

[0013]

For this reason, in a case where an image for the right eye is generated, pixels for displaying the object (1a) closer to the image acquisition mechanism are shifted more toward the left, whereas pixels for displaying the farther object (1b) are shifted less toward the left. It can be gleaned from an image (21d) viewed from a camera (20d) orchestrated at a hypothetical position shifted toward the left that a steric image can be generated by shifting pixels for displaying the object (1a) closer to the image acquisition mechanism more toward the right and by shifting pixels for displaying the farther object (1b) less toward the right. It thus becomes possible to obtain a steric image by designating the direction for shifting pixels constituting an image picked up by a camera depending on the perspectiveal shift direction and by shifting said pixels more as the perspectiveal shift magnitude increases or as the displayed object becomes closer.

[0014]

In other words, it becomes possible, by sighting the right eye-bound image thus generated with the right eye and the left eye-bound image with the left eye, to obtain a binocular view image.

[0015]

A polyocular view image can likewise be obtained by generating, from a singular image, images picked up from multiple perspectives by varying the shift magnitudes thereof depending on distances based on the aforementioned method.

[0016]

The imaging device of the present invention may, furthermore, use, as the aforementioned distance acquisition mechanism, one constituted by an irradiation mechanism capable of irradiating, onto the aforementioned photographic subject, beams almost simultaneously from multiple light emission positions bearing mutually different divergent irradiation distances to the aforementioned photographic subject, an imaging mechanism capable of independently picking up beam images arising as a result of the reflection, by the aforementioned photographic subject, of beams emitted from the respective light emission positions of said irradiation mechanism, and a computation mechanism designed to calculate distances from the light emission positions of the respective independently picked up blocks corresponding to the aforementioned respective reflection beams by means of computation based on the reflection intensity ratios of the aforementioned respective blocks.

[0017]

The "divergent irradiation distance" hereby signifies a distance over which beams progress divergently in such a way that the luminosity per unit irradiation area will become inversely proportional to a square of the distance, whereas distances over which they progress as parallel beams and distances over which they progress within optical fibers are excluded. Moreover, "almost simultaneously" signifies either simultaneity or a time differential over which no photographic subject motion is acknowledged.

[0018]

Next, a computation method for calculating the distance from an image picked up monocularly will be explained with reference to the principle diagram shown in Figure 3.

[0019]

Beams are irradiated onto a photographic subject (2) from a pair of point light sources (30) & (31) bearing mutually different distances from the photographic subject (2). In a case where the luminosity of the point light source (30) closer to the photographic subject is defined as a preknown value L_1, the luminosity of the point light source (31) farther from the photographic subject as a preknown value L_2, the distance between both point light sources (30) & (31) as a preknown value L, the distance from the point light source (30) to the photographic subject as R_1, the distance from the point light source (31) to the photographic subject as R_2, and the spectral reflectance of the photographic subject in relation to the beams emitted from the respective point light sources (30) & (31) as Rf,

$$R_1 + L = R_2 \ldots (1)$$

can be ascertained from the positional relationship of the respective elements, whereas in a case where the reflection beam intensity of the beams emitted from the point light source (30) and reflected by the photographic subject (2) is defined as Lr_1,

$$Lr_1 = Rf \cdot L_1/4\pi R_1^2 \ldots (2)$$

can be ascertained, whereas in a case where the reflection beam intensity of the beams emitted from the point light source (31) and reflected by the photographic subject (2) is defined as Lr_2,

$$Lr_2 = Rf \cdot L_2/4\pi R_2^2 \ldots (3)$$

can be ascertained.

[0020]

In a case where the ratio of the respective reflection beam intensities is hereby calculated as Wr,

$$Wr = Lr_1/Lr_2 = Rf \cdot L_1 \cdot 4\pi R_2^2/r\pi R_1^2 \cdot Rf \cdot L_1 \cdot R_2^2/L_2 \cdot R_1^2 \ldots (4)$$

can be ascertained, whereas in a case where the formula (1) is substituted into the formula (4) for transforming the latter into a formula for calculating the distance R_1 to the photographic subject, the following can be obtained:

[Numerical 1]:
$$R_1 = \frac{L}{\left(\sqrt{\frac{WrL_2}{L_1}} - 1\right)} \quad (5)$$

[0021]

According to the formula (5), L_1, L_2, & L are preknown values, whereas since Wr can be calculated from the luminosity ratio of the respective pixels of a pair of picked up images, it becomes possible to ascertain the distance R1 to the photographic subject.

[0022]

It becomes possible, in a case where the aforementioned computing routines are executed, in relation to the respective pixels of the picked up images, by a computer designed to input & compute reflection beam images originating from the point light sources (30) & (31) and picked up by the camera (20), to ascertain distances to the respective blocks of the photographic subject from the picked up images.

[0023]

Mutually identical mechanisms can, furthermore, be used as the respective image pickup mechanisms of the aforementioned image acquisition mechanism and the aforementioned distance acquisition mechanism.

[0024]

As far as the imaging device of the present invention is concerned, the steric image generation mechanism may be designed to be capable of varying the parallax magnitude and/or of determining the parallax magnitude depending on the magnifying ratio of the image displayed on the display mechanism. /4

[0025]

As far as the imaging device of the present invention is concerned, the steric image generation mechanism may be designed to be capable of generating binocular view images and/or of generating polyocular view images.

[0026]

As far as the imaging device of the present invention is concerned, furthermore, an endoscope may be provided as the image acquisition mechanism.

[0027]

(Effects of the invention)

Since the imaging device of the present invention thus constituted is capable of generating steric images from images acquired by the image acquisition mechanism of a monocular optical system, it becomes possible, by preventing a device size enlargement, to provide a relatively compact imaging device capable of steric imaging.

[0028]

(Application embodiments of the invention)

In the following, concrete application embodiments of the present invention will be explained with reference to figures. Figure 1 is a diagram which shows an approximate constitution of the endoscope device of the present application embodiment.

[0029]

The distance acquisition mechanism of the present application embodiment hereby uses a method wherein distances to a photographic subject are calculated by almost simultaneously irradiating beams onto a photographic subject from multiple light emission positions bearing mutually different divergent irradiation distances, by independently picking up beam images arising as a result of the reflection, by said photographic subject, of said beams, and by calculating distances from the light emission positions of the respective blocks corresponding to the said picked up reflection beam images by means of computation based on the reflection intensity ratio of the respective blocks.

[0030]

The imaging device of the present application embodiment is constituted by a camera (100), a pair of light sources (104) & (105) configured on said camera (100) for irradiating, onto a photographic subject (1), beams from a pair of positions (50a) & (50b) bearing mutually different divergent irradiation distances thereto, a computer (140) endowed with a function of outputting, based on a pair of images picked up by the camera (100), not only a normal image but also imaged signals by calculating the distance distribution information, a steric image generation mechanism (141) designed to generate a steric image based on the normal image & distance distribution information transmitted from the computer (140), and a head mount display (120) designed, upon the reception of an image output signal from the steric image generation mechanism (141), to display a binocular view image.

[0031]

An objective lens (101) is configured on the distal end of the interior of the camera (100), whereas an imaging element (102) comprising of large numbers of CCD elements is configured on the rear plane of the same, whereas the distal end of a CCD cable (103) is connected to said imaging element (102). The proximal end of the CCD cable (103) is connected to the computer (140).

[0032]

Next, the functions of the imaging device of the present application embodiment thus constituted will be explained.

[0033]

First, a white beam for picking up a normal image is irradiated onto the photographic subject (1) from the light source (104) attached to the camera (100) and bearing a shorter distance to the photographic subject. A reflection beam obtained as a result of the reflection of the white beam by the photographic subject (1) is collected by the objective lens (101) and then focused on the imaging element (102). An image signal

obtained from the imaging element (102) is transmitted, via the CCD cable (103), to the computer (140) and then saved within a memory inside the computer (140).

[0034]

NEXT, a white beam for picking up a normal image is irradiated onto the photographic subject (1) from the light source (105) attached to the camera (100) and bearing a longer distance to the photographic subject. A reflection beam obtained as a result of the reflection of the white beam by the photographic subject (1) is collected by the objective lens (101) and then focused on the imaging element (102). An image signal obtained from the imaging element (102) is transmitted, via the CCD cable (103), to the computer (140) and then saved within a memory inside the computer (140).

[0035]

The reflection beam image of the beam emitted from the long-distance light source (105) and the reflection beam image of the beam emitted from the short-distance light source (104) are thus independently picked up in synchrony with the light emission switch of the light sources.

[0036]

Next, distances to the respective blocks of the photographic subject are computed, based on the above-mentioned principle, from the pair of picked up images by the computer (140) for calculating distances specific to the respective pixels of the images. Either of the pair of picked up images, furthermore, is also used as a normal image.

[0037]

The normal image and distance information thus obtained are transmitted to the steric image generation mechanism (141) from the computer (140). A right eye-bound image and a left eye-bound image are generated by the steric image generation mechanism (141) based on the transmitted normal image & distance information according to the above-mentioned principle, whereas these images become displayed on the head mount display (120).

[0038]

The left & right shift magnitudes, from the original image, of the respective pixels of the right eye-bound & left eye-bound images constituting the binocular view image displayed on the head mount display (120) are determined depending on the distances thereof to the photographic subject based on the above-mentioned principle, whereas the magnitudes for shifting the respective pixels are multiplied by a coefficient depending on the left & right parallax magnitude. The steric appearance can be emphasized or deemphasized by adjusting this coefficient.

[0039]

It is also possible, furthermore, to automatically determine the degree to which the parallax is emphasized or deemphasized without imposing a burden on an observer by emphasizing the steric appearance in a case where the magnifying ratio of the displayed image is high and by deemphasizing the steric appearance in a case where said magnifying ratio is low.

[0040]

The imaging device of the present invention thus constituted is capable, by virtue of the pervasion of a monocular optical system as an image acquisition mechanism, of providing a compact steric imaging device by preventing the device size enlargement.

[0041]

As far as the present application embodiment is concerned, distances to the respective blocks of a photographic subject are measured based on a method wherein distances to a photographic subject are ascertained by almost simultaneously irradiating beams onto a photographic subject from multiple light emission positions bearing mutually different divergent irradiation distances, by independently picking up beam images arising as a result of the reflection, by said photographic subject, of said beams, and by calculating distances from the light emission positions of the respective blocks corresponding to said picked up reflection beam images by means of computation based on the reflection intensity

ratio of the respective blocks, although all conceivable distance acquisition mechanisms can be used so long as they are means capable of acquiring distances to the respective blocks of a photographic subject.

[0042]

Moreover, although a head mount display is used in the present application embodiment as a unit for displaying a binocular view image, all other conceivable means /5 capable of displaying binocular view images can be used.

[0043]

A case where a polyocular view image is generated in the present application embodiment, furthermore, will be explained with reference to Figure 2 & Figure 4. In this case, a photographic subject (1a) abiding at a short distance and a photographic subject (1b) abiding at a long distance are picked up by using a monocular camera (20a).

[0044]

Based on a singular image (21a) picked up by the camera (20a), images (21b), (21c), (21d), & (21e) bearing the respective parallaxes hypothesized to have arisen as a result of the pickup thereof by cameras (20b), (20c), (20d), & (20e) hypothesized to be configured on the left & right of said camera (20a) are generated by the computer (140) & steric image generation unit (142) in accordance not only with the distances to the photographic subjects (1a) & (1b) calculated based on the above-mentioned method but also with the respectively hypothesized camera positions. These five images constitute a polyocular view image bearing mutually different parallaxes and are displayed on the steric image display unit (130).

[0045]

The steric image display unit (130) used in this case may be any means capable of displaying polyocular view images such as the constitution designed to use lenticular lenses disclosed by Japanese Patent Application Publication Kokai No. Hei 11[1999]-308642. In a case where lenticular lenses are used, the five images (21a) ~ (21e) provided as foundations

of the aforementioned polyocular view image are displayed after having been processed specifically for said lenticular lenses and sterically viewed together with said lenses.

[0046]

Next, the second application embodiment of the present invention will be explained. The second application embodiment instantiates a case where the imaging device of the present invention has been applied to an endoscope, whereas Figure 5 shows an approximate constitution of the present application embodiment.

[0047]

The endoscope device of the present application embodiment is constituted by an endoscope (200) to be inserted into a subject's body cavity, an illumination unit (260) in possession of a pair of light sources (262) & (265) configured at an interior position in the vicinity of the distal end of said endoscope (200) for irradiating beams from a pair of positions (51a) & (51b) bearing mutually different divergent irradiation distances to a photographic subject (10), a computer (240) endowed not only with a function of outputting signals imaged by calculating a normal image signal & distance distribution information based on a pair of images picked up, via an objective lens (201), by an image pickup element (202) within the endoscope (200) but also with a function of controlling the entire endoscope device, a steric image generation unit (241) designed to generate a steric image based on the normal image & distance distribution information transmitted from the computer (240), and a head mount display (120) designed to display a binocular view image upon the reception of the image output signals from the steric image generation unit (241).

[0048]

The endoscope (200) possesses, in the interior thereof, a CCD cable (204) extending to the distal end thereof, a short-distance light guide (206), & a long-distance light guide (208). The image pickup element (202) is connected to the distal end of the CCD cable (204), whereas a reflective prism (203) is attached to said image pickup element (202). The objective lens (201), short-distance illuminating lens (205), & long-distance illuminating

lens (207) are configured at the respective distal ends of the reflective prism (203), short-distance light guide (206), & long-distance light guide (208), namely at the distal end of the endoscope (200). The proximal end of the CCD cable (204) is connected to the computer (240), whereas the respective proximal ends of the short-distance light guide (206) & long-distance light guide (208) are connected to the illumination unit (260).

[0049]

The illumination unit (260) possesses a short-distance white light source (262), which emits white beams for the normal image and which serves as a light source for irradiating beams via the short-distance illuminating lens (205) from the endoscope (200) past the short-distance light guide (206), a short-distance white light source-specific electric power source (263) connected electrically to said short-distance white light source (262), a short-distance white light collection lens (261) for collecting the white beams emitted from the short-distance white light source (262), a long-distance white light source (265), which emits white beams for the normal image and which serves as a light source for likewise irradiating beams via the long-distance illuminating lens (207) from the endoscope (200) past the long-distance light guide (208), a long-distance white light source-specific electric power source (266) connected electrically to said long-distance white light source electric power source (265), and a long-distance white light collection lens (264) for collecting the white beams emitted from the long-distance white light source-specific electric power source (265).

[0050]

A CCD cable (204) extending from the endoscope (200) is connected to the computer (240).

[0051]

Next, the functions of the endoscope device of the present application embodiment thus constituted will be explained.

[0052]

First, the endoscope (200) is inserted into a subject's body cavity by an operator's hand. Subsequently, the short-distance white light source-specific electric power source (263) is driven, and white beams become emitted from the short-distance white light source (262). The white beams enter the light guide (206) via the short-distance white light collection lens (261), guided to the distal end of the endoscope (200), and then irradiated onto the photographic subject (10) via the illuminating lens (205) bearing a shorter distance to the photographic subject (10). Reflection beams arising as a result of the reflection of the white beams by the photographic subject (10) are collected by the objective lens (201), reflected by the reflective prism (203), and then focused on the normal image pickup element (202). Image signals obtained from the image pickup element (202) are transmitted, via the CCD cable (204), to the computer (240) and then saved within a memory inside the computer (240).

[0053]

Next, the long-distance white light source (266) is driven in a manner similar to that for driving the short-distance white light source, as a result of which white beams become emitted from the long-distance white light source -specific electric power source (265). The white beams enter the light guide (208) via the long-distance white light collection lens (264), guided to the distal end of the endoscope (200), and then irradiated onto the photographic subject (10) via the illuminating lens (207) bearing a longer distance to the photographic subject (10). Reflection beams arising as a result of the reflection of the white beams by the photographic subject (10) are collected by the objective lens (201), reflected by the reflective prism (203), and then focused on the normal image pickup element (202). Image signals obtained from the image pickup element (202) are transmitted, via the CCD cable (204), to the computer (240) and then saved within a memory inside the computer (240).

[0054]

Thus, reflection beam images of beams emitted from the long-distance light source and reflection beam images of beams emitted from the short-distance light source are independently picked up in synchrony with the light emission switch of the light sources. /6

[0055]

Next, distances to the respective blocks of the photographic subject are computed by the computer (240) based on the pair of picked up images according to the above-mentioned principle for calculating distances specific to the respective pixels of said images, whereas distance information is calculated by summarizing these data. Either of the pair of picked up images, furthermore, is also used as a normal image.

[0056]

The normal image & distance information thus processed are transmitted to the steric image generation unit (241) from the computer (240). A right eye-bound image & a left eye-bound image are generated by the steric image generation unit (241) based on the normal image & distance information thus transmitted according to the above-mentioned principle, whereas these images are displayed on the head mount display (120). It is thus that images of the endoscope can be viewed as steric images.

[0057]

According to the present application embodiment, too, the steric appearance can be emphasized or deemphasized according to procedures similar to those in the first application embodiment, and it is also possible to automatically determine the degree to which the parallax is emphasized or deemphasized depending on the magnifying ratios of the displayed images.

[0058]

The imaging device of the present application embodiment thus constituted, too, yields effects similar to those imputed to the first application embodiment.

[0059]

In the present application embodiment, too, distances to the respective blocks of a photographic subject are measured based on a method wherein distances to a photographic subject are ascertained by almost simultaneously irradiating beams onto a photographic subject from multiple light emission positions bearing mutually different divergent irradiation distances, by independently picking up beam images arising as a result of the reflection, by said photographic subject, of said beams, and by calculating distances from the light emission positions of the respective blocks corresponding to the said picked up reflection beam images by means of computation based on the reflection intensity ratio of the respective blocks, although all conceivable distance acquisition mechanisms can be used so long as they are means capable of achieving the objective of the present invention.

[0060]

In the present application embodiment, too, furthermore, a head mount display is used as a unit for displaying a binocular view image, although all other conceivable means capable of displaying binocular view images can be used.

[0061]

In the present application embodiment, too, furthermore, it is also possible to generate & display polyocular view images according to procedures similar to those in the first application embodiment.

Brief explanation of the figures

Figure 1: An approximate constitutional diagram pertaining to one imaging device of the first application embodiment of the present invention.

Figure 2: A principle diagram pertaining to a steric image generation method used in the present invention.

Figure 3: A principle diagram pertaining to a distance computation method used in the present invention.

Figure 4: An approximate constitutional diagram pertaining to another imaging device of the first application embodiment of the present invention.

Figure 5: An approximate constitutional diagram pertaining to one imaging device of the second application embodiment of the present invention.

Figure 6: An approximate constitutional diagram pertaining to another imaging device of the second application embodiment of the present invention.

(Explanation of notations)

(1): Photographic subject;

(100): Camera;

(120): Head mount display;

(121): Image cable;

(130): Steric image display unit;

(140) & (240): Computers;

(141) & (241): Steric image generation mechanisms;

(142) & (242): Steric image generation units;

(200): Endoscope;

(260): Illumination unit.

Figure 2

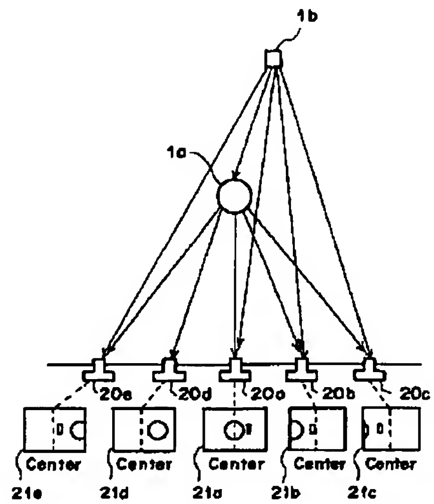


Figure 3

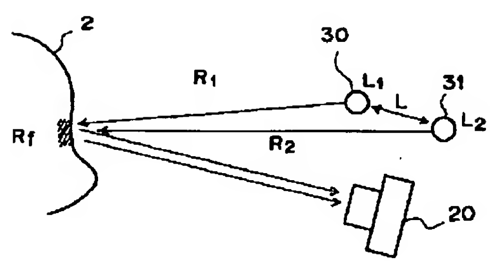


Figure 1

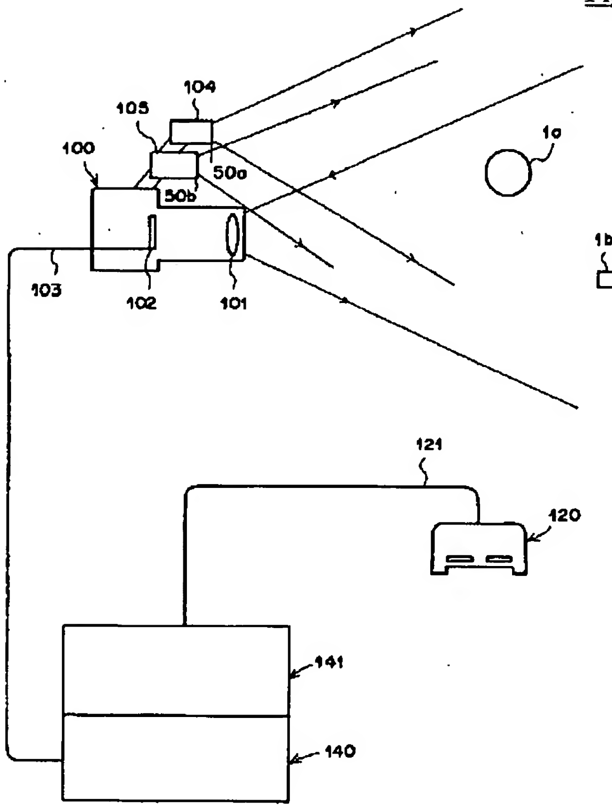


Figure 4

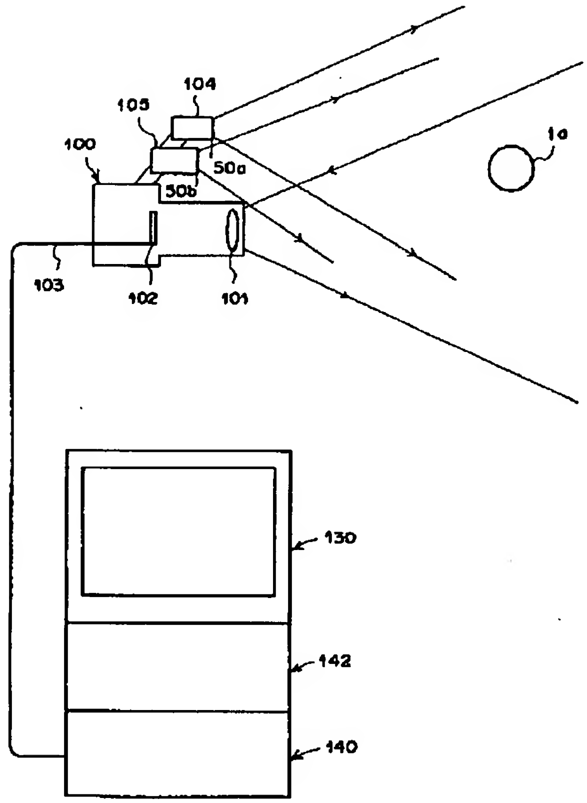


Figure 5

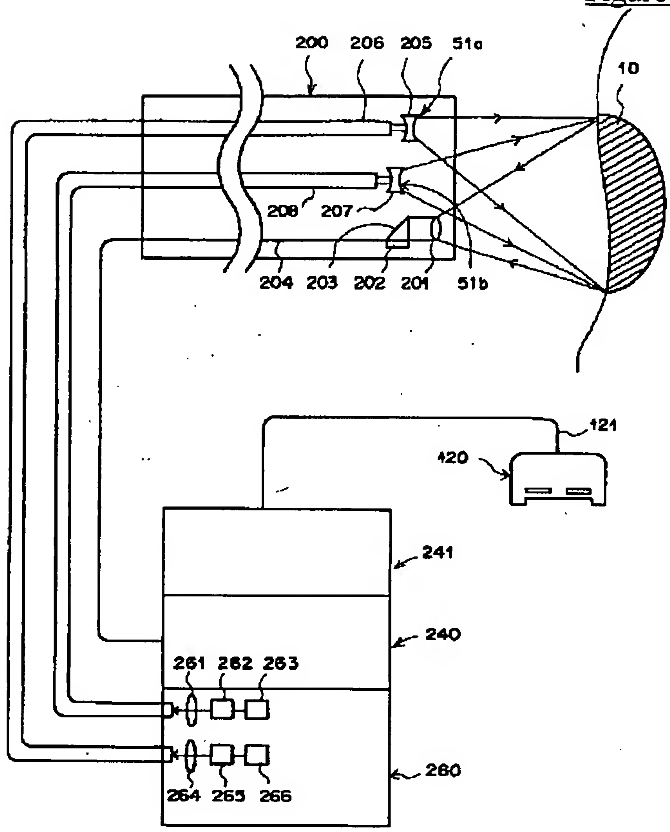
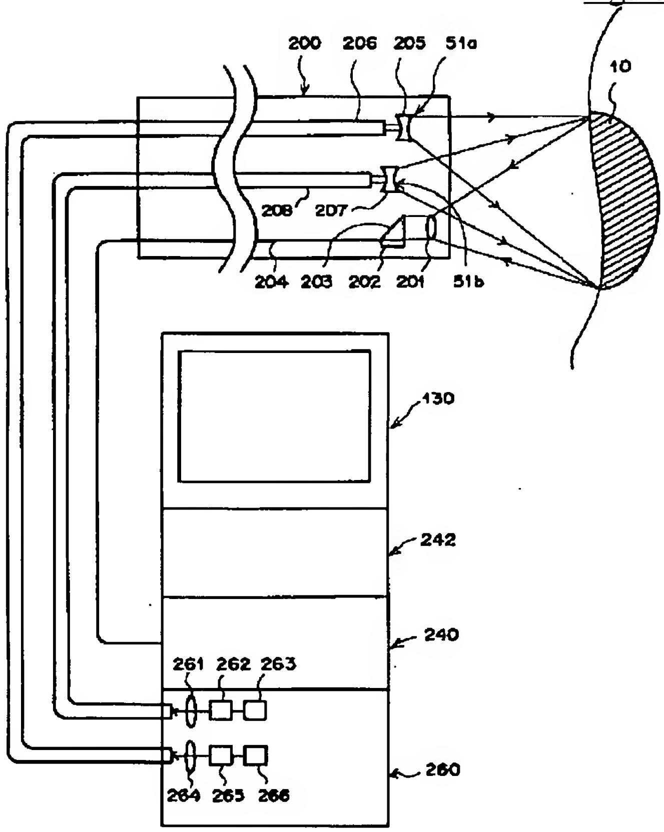

200
206
205
51a
10
208
207
204
203
202
201
51b
121
420
241
240
261
262
263
264
265
266
260

Figure 6


200
206
205
51a
10
208
207
204
203
202
201
51b
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